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Su et al.

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(54) **MULTIMEDIA STREAM BUFFER AND OUTPUT METHOD AND MULTIMEDIA STREAM BUFFER MODULE**

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H04N 7/173 (2011.01)

(52) **U.S. Cl.**
CPC ***H04L 65/80*** (2013.01); ***H04L 65/4084*** (2013.01); *H04N 7/173* (2013.01)

(58) **Field of Classification Search**
None
See application file for complete search history.

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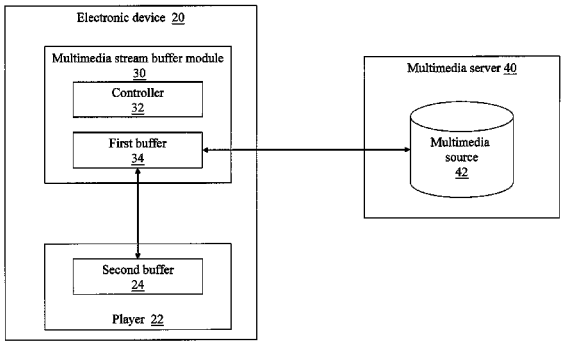
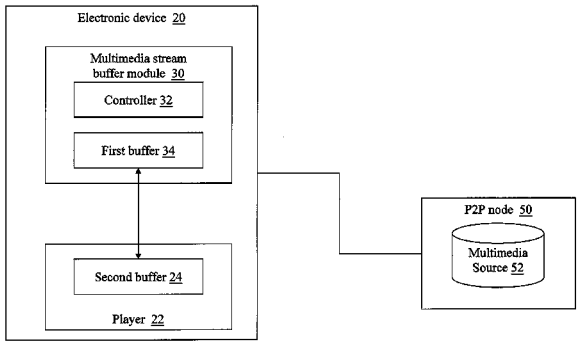
(57) **ABSTRACT**

A buffer and output method and a buffer module for a multimedia stream are provided, wherein multimedia stream packets are received and stored into a first buffer, and when an actual remaining time calculated according to an accumulated idle time and a buffer time, is greater than a remaining time threshold value, following steps are performed. A first present time is read, and a sleep instruction is executed, so as to wait for a preset idle time. A second present time is read, and an actual idle time different from the preset idle time is calculated according to the first present time and the second present time. A part of buffer units are enabled according to the accumulated idle time accumulated according to the actual idle time, to output the stored multimedia stream packets to a second buffer of a player.

18 Claims, 9 Drawing Sheets





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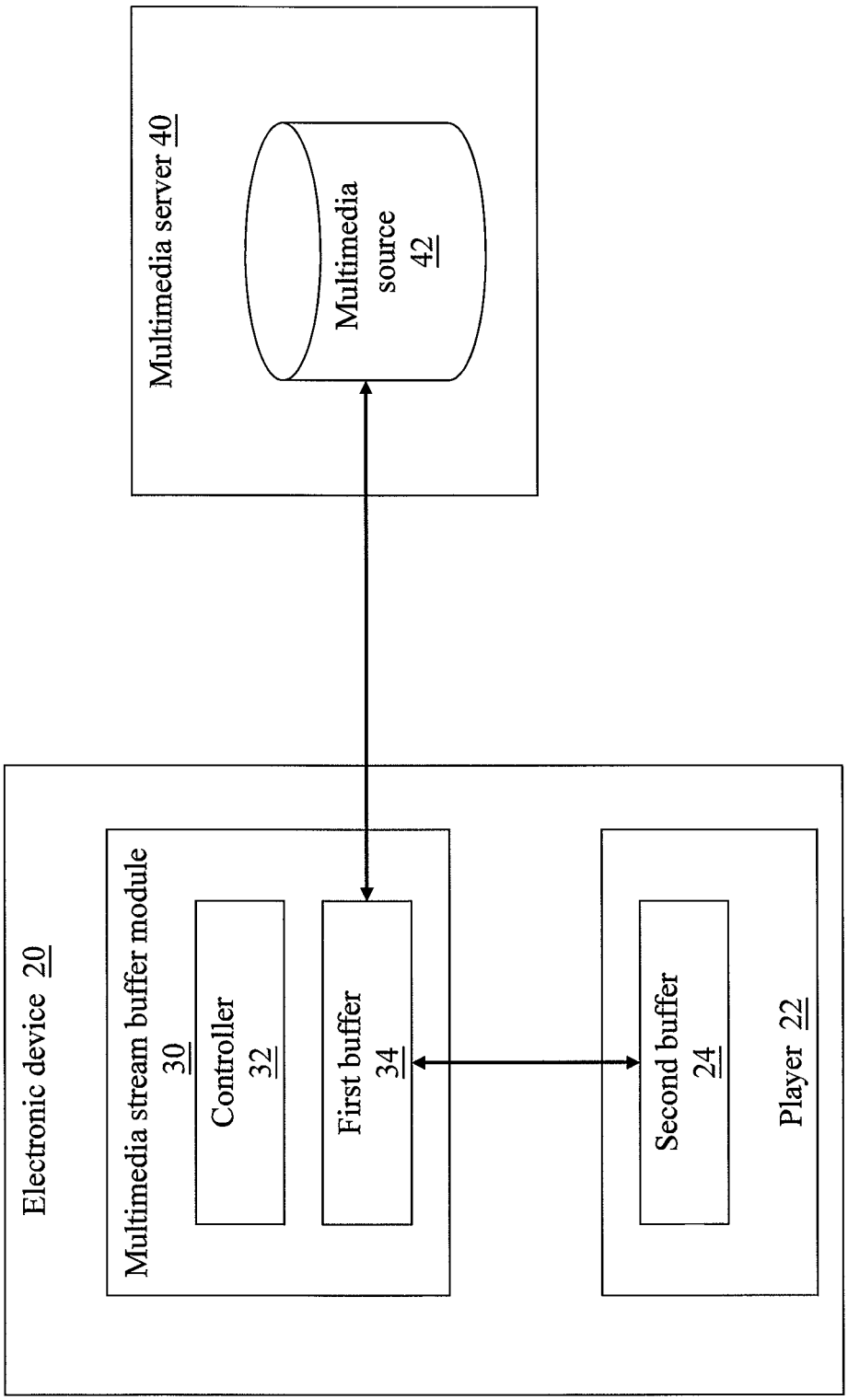
Multimedia server 40
Multimedia source 42
Electronic device 20
Multimedia stream buffer module 30
Controller 32
First buffer 34
Second buffer 24
Player 22

FIG. 1A

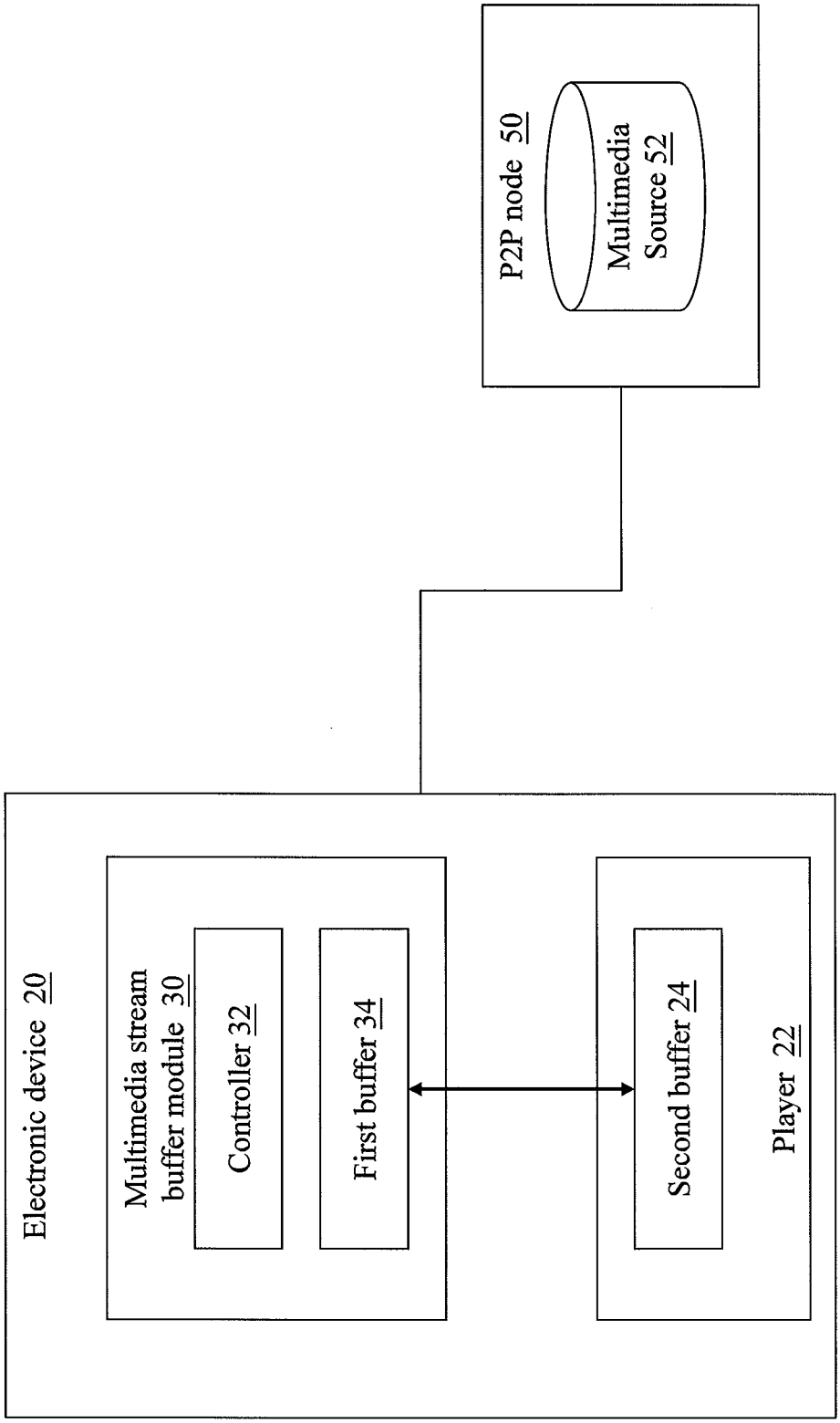
P2P node 50
Multimedia Source 52
Electronic device 20
Multimedia stream buffer module 30
Controller 32
First buffer 34
Second buffer 24
Player 22

FIG. 1B

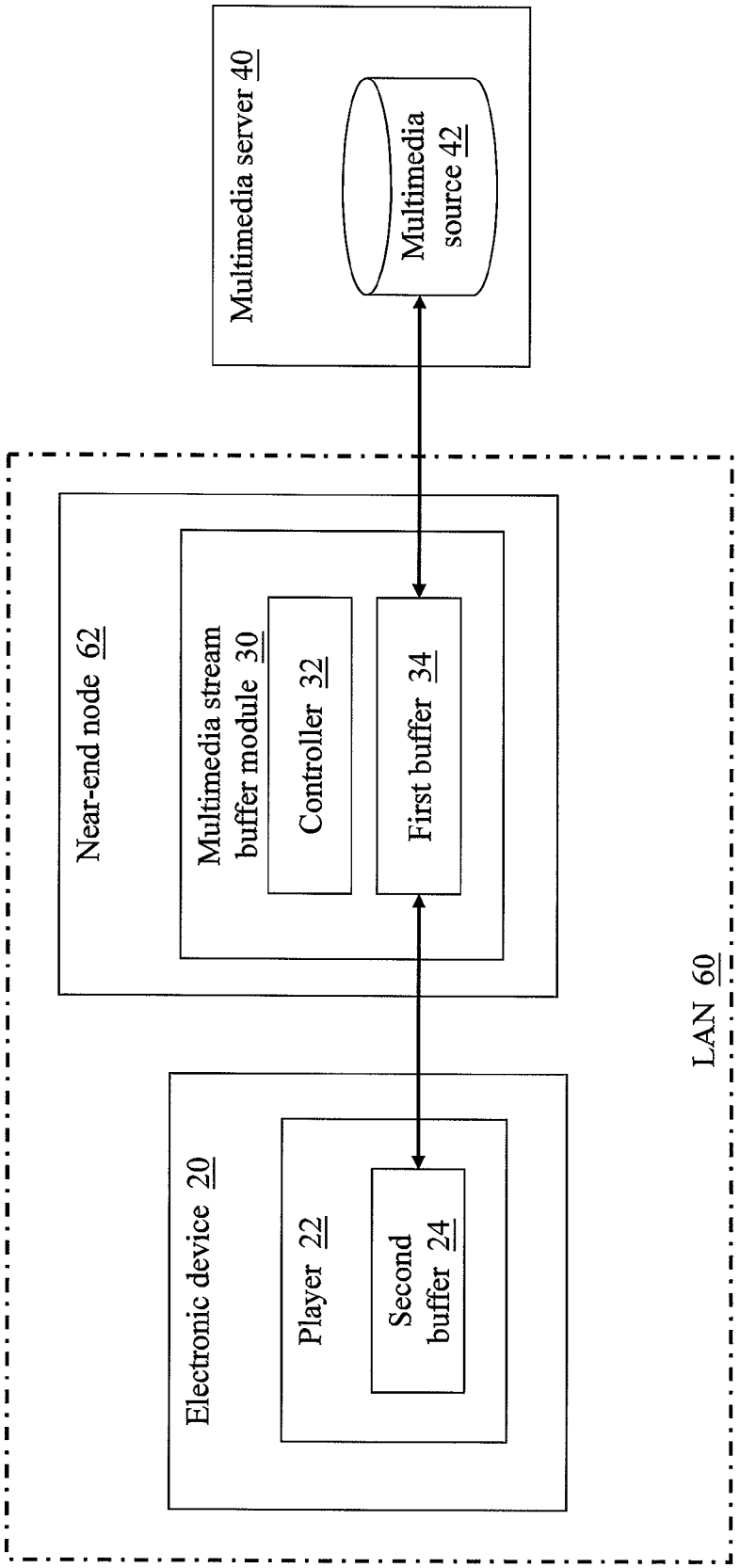
Multimedia server 40
Multimedia source 42
Near-end node 62
Multimedia stream buffer module 30
Controller 32
First buffer 34
Electronic device 20
Player 22
Second buffer 24
LAN 60

FIG. 1C

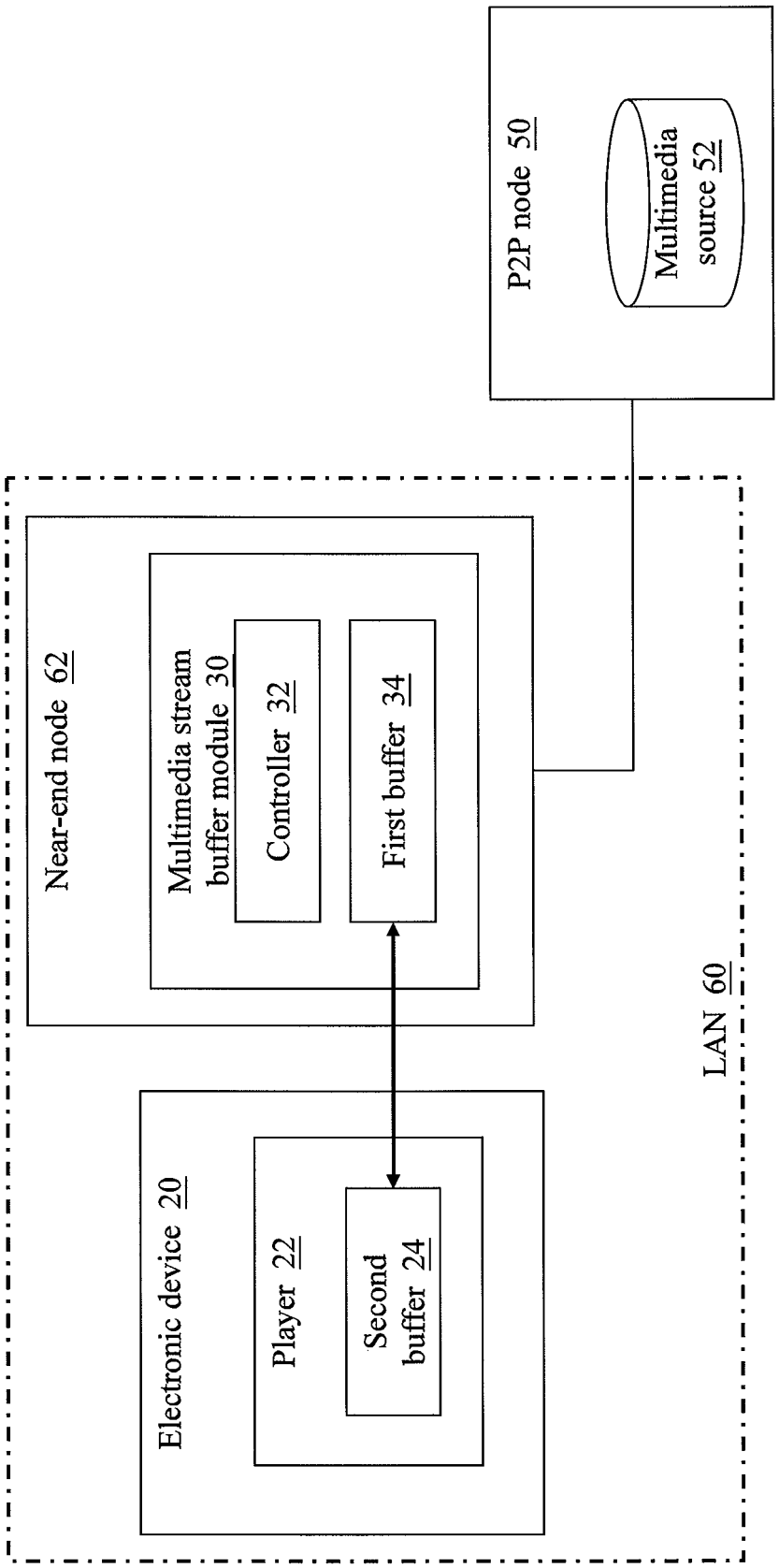
P2P node 50
Multimedia source 52
LAN 60
Near-end node 62
Multimedia stream buffer module 30
Controller 32
First buffer 34
Electronic device 20
Player 22
Second buffer 24

FIG. 1D

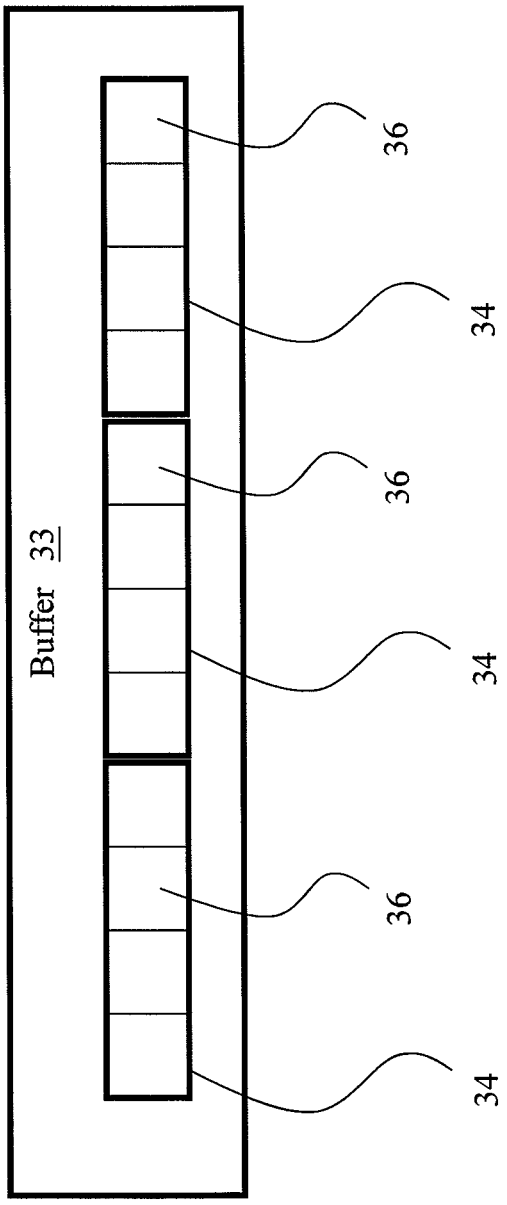

FIG. 2

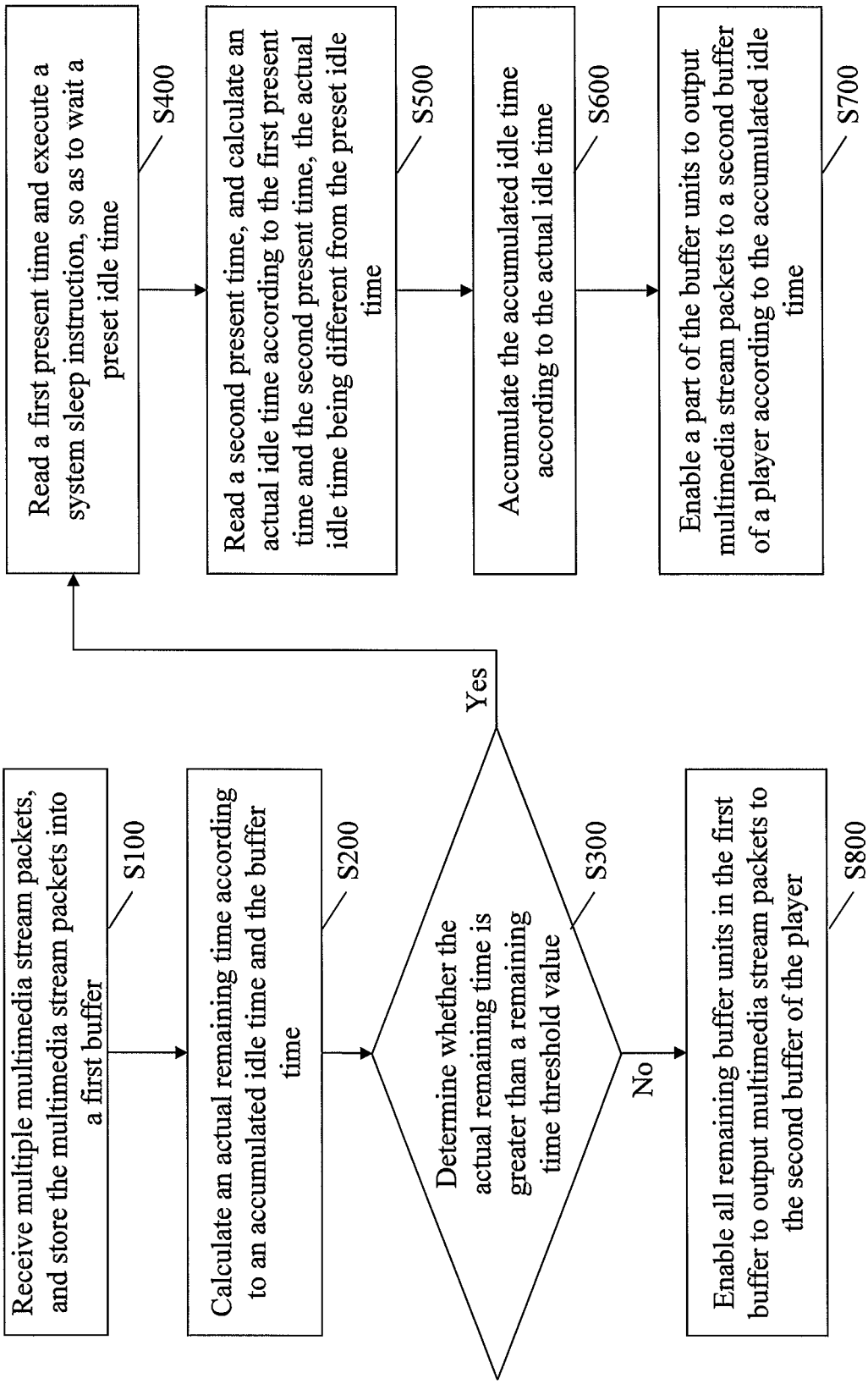
Receive multiple multimedia stream packets, and store the multimedia stream packets into a first buffer
S100
Calculate an actual remaining time according to an accumulated idle time and the buffer time
S200
Determine whether the actual remaining time is greater than a remaining time threshold value
S300
Yes
No
Read a first present time and execute a system sleep instruction, so as to wait a preset idle time
S400
Read a second present time, and calculate an actual idle time according to the first present time and the second present time, the actual idle time being different from the preset idle time
S500
Accumulate the accumulated idle time according to the actual idle time
S600
Enable a part of the buffer units to output multimedia stream packets to a second buffer of a player according to the accumulated idle time
S700
Enable all remaining buffer units in the first buffer to output multimedia stream packets to the second buffer of the player
S800

FIG. 3

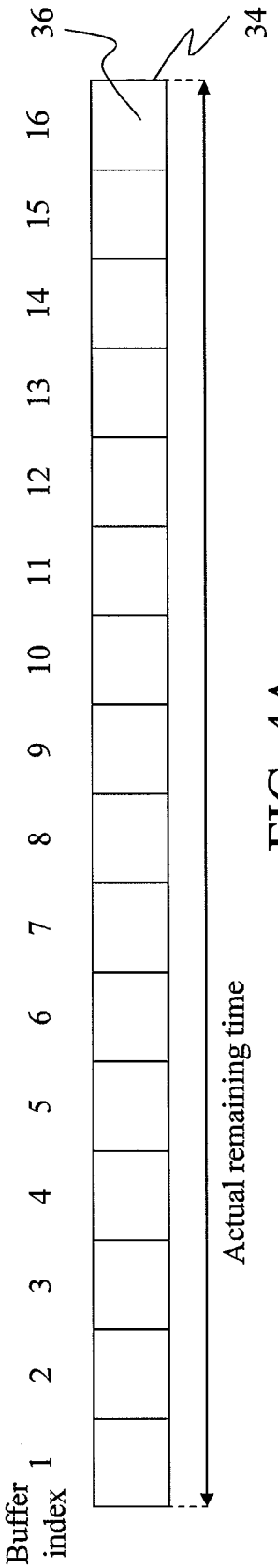
Buffer index
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
36
34
Actual remaining time

FIG. 4A

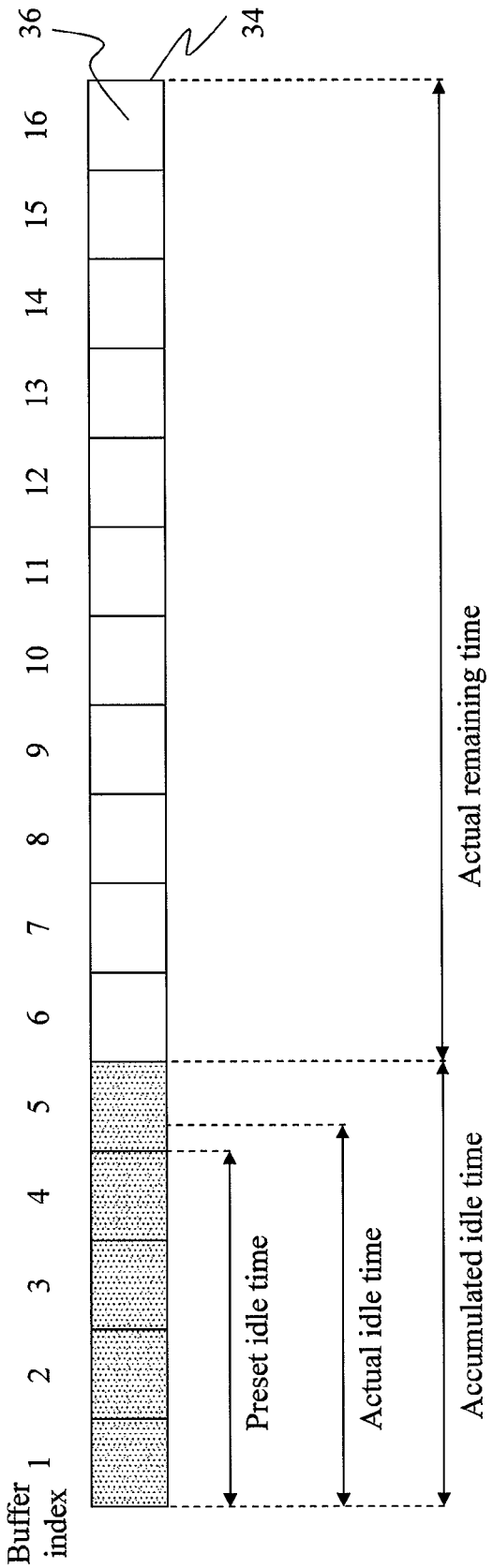
Buffer index
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
36
34
Preset idle time
Actual idle time
Accumulated idle time
Actual remaining time

FIG. 4B

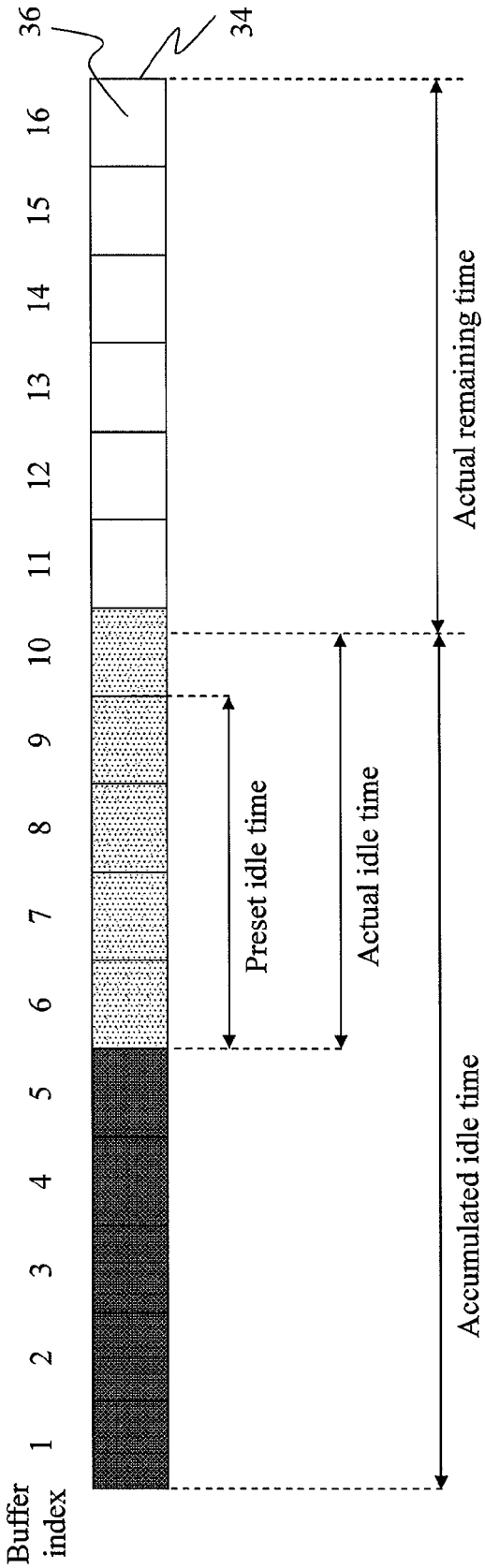
36
34
Buffer index
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
Preset idle time
Actual idle time
Actual remaining time
Accumulated idle time

FIG. 4C

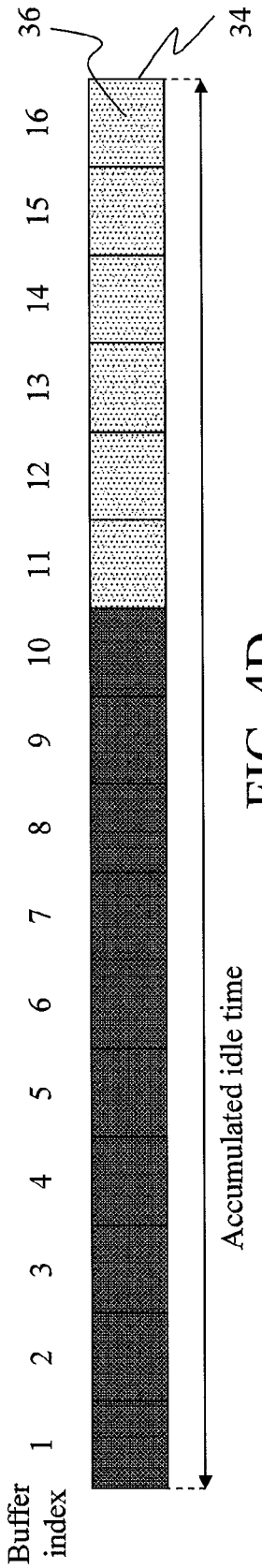
36
34
Buffer index
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
Accumulated idle time

FIG. 4D

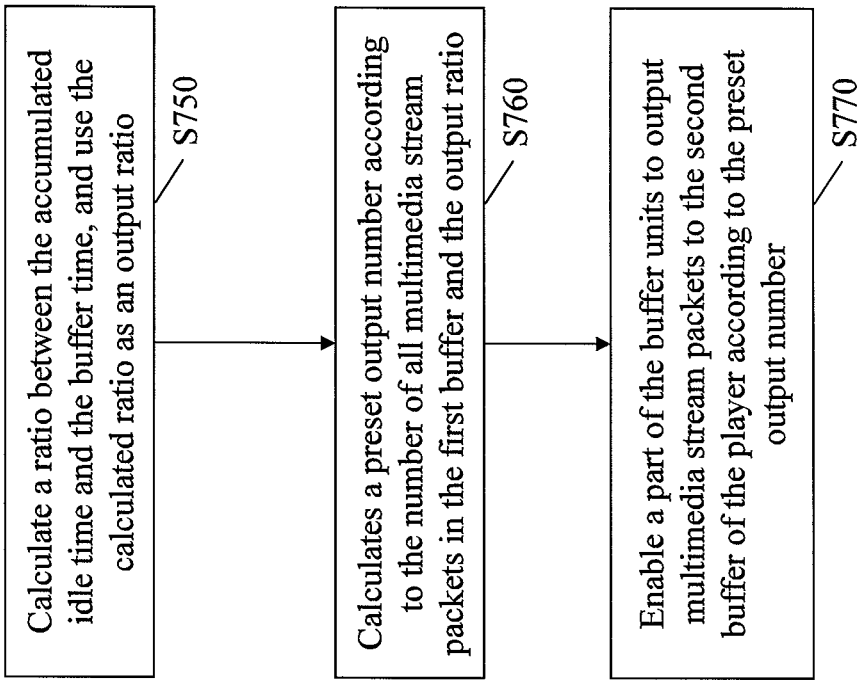
Calculate a ratio between the accumulated idle time and the buffer time, and use the calculated ratio as an output ratio
S750
Calculates a preset output number according to the number of all multimedia stream packets in the first buffer and the output ratio
S760
Enable a part of the buffer units to output multimedia stream packets to the second buffer of the player according to the preset output number
S770

FIG. 6

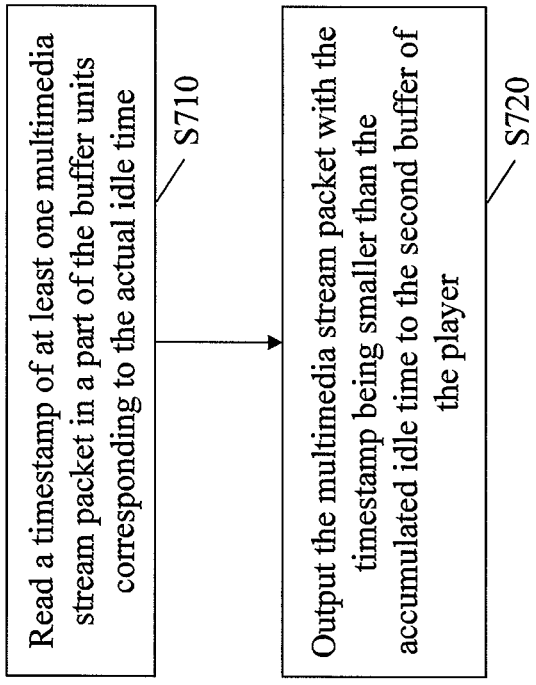
Read a timestamp of at least one multimedia stream packet in a part of the buffer units corresponding to the actual idle time
S710
Output the multimedia stream packet with the timestamp being smaller than the accumulated idle time to the second buffer of the player
S720

FIG. 5

MULTIMEDIA STREAM BUFFER AND OUTPUT METHOD AND MULTIMEDIA STREAM BUFFER MODULE

CROSS-REFERENCE TO RELATED APPLICATIONS

This non-provisional application claims priority under 35 U.S.C. §119(a) on patent application Ser. No. 10/114,5746 filed in Taiwan, R.O.C. on Dec. 5, 2012, the entire contents of which are hereby incorporated by reference.

TECHNICAL FIELD

The disclosure relates to a multimedia stream buffer and output method and a multimedia stream buffer module.

BACKGROUND

With a multimedia stream technology, it is not required to download a complete multimedia file before playing; instead, the multimedia stream can be downloaded gradually and downloaded segments/chunks can be played. With the popularization of wireless and cable broadband network services, it has become a major network application to use a computer or a handheld device to watch multimedia streams through the network. In order to play the multimedia stream smoothly, the received partial stream data needs to be stored in a near-end storage device or a local storage device, and then is output to a playback buffer of a player, so as to be decoded and displayed.

The playback buffer size of a handheld device or a lightweight player is usually relatively small, unknown, or cannot be configured arbitrarily, which causes buffer overflow or underflow, and further results in problems such as unsmooth video playback, image jitter/flicker or freeze while playing. Especially in pursuit of high definition, when the multimedia stream is originated from a high definition video source, problems such as unsmooth video playback, image jitter/flicker or freeze are more likely to occur in a player using a playback buffer with a small size.

To solve the problem of unsmooth video playback, the current player tried to control the output of the playback buffer, so as to acquire stream data from the near-end storage device or from the local storage device for decoding. However, a general control method is implemented based on complex communication protocols such as a Real Time Streaming Protocol (RTSP) and a Real-time Transport Control Protocol (RTCP), and with reference to complicated information such as a network transmission rate, stream bit-rate/data size, or the remaining storage space. Therefore, many lightweight players do not support this function.

In addition, the output control of the buffer is implemented on a software layer of an operating system through a sleep instruction provided by the operation system. Therefore, based on a timestamp of data content, the conventional method fails to perform the precise control on a hardware clock directly. This causes that unpredictable jitters to the time point when the execution of the sleep instruction is started, and to the time point when the execution of the sleep instruction is finished, thereby failing to implement the precise output control of the buffer. The output error also increases with time, which finally causes problems such as unsmooth video playback, image jitter/flicker or even playback freeze.

SUMMARY

The disclosure provides a multimedia stream buffer and output method and a multimedia stream buffer module, and the multimedia stream buffer module can be used to perform the multimedia stream buffer and output method.

According to one embodiment, the multimedia stream buffer and output method is provided, it comprises following steps. A plurality of multimedia stream packets are received and are stored into a first buffer, and the first buffer corresponds to a buffer time. An actual remaining time is calculated according to an accumulated idle time and the buffer time. When the actual remaining time is greater than a remaining time threshold value, following steps are preformed. A first present time is read, and a sleep instruction of the operation system is executed, so as to wait for a preset idle time. A second present time is read, and an actual idle time is calculated according to the first present time and the second present time. The actual idle time is different from the preset idle time. The accumulated idle time is accumulated according to the actual idle time. A part of the buffer units are enabled according to the accumulated idle time to output the stored multimedia stream packets to a second buffer of a player.

According to another embodiment, the multimedia stream buffer module is provided, it comprises a first buffer and a controller. The first buffer is used for storing a plurality of multimedia stream packets. The first buffer corresponds to a buffer time, and is divided into a plurality of buffer units according to a time unit. The multimedia stream packets are received and are stored into the first buffer. An actual remaining time is calculated according to an accumulated idle time and the buffer time. When the actual remaining time is greater than a remaining time threshold value, the controller performs following steps. A first present time is read, and a sleep instruction is executed, so as to wait for a preset idle time. A second present time is read, and an actual idle time is calculated according to the first present time and the second present time. The actual idle time is different from the preset idle time. The accumulated idle time is calculated according to the actual idle time. A part of the buffer units is enabled according to the accumulated idle time to output the stored multimedia stream packets to a second buffer of a player.

BRIEF DESCRIPTION OF THE DRAWINGS

The disclosure will become more fully understood from the detailed description given herein below for illustration only and thus does not limit the disclosure, wherein:

FIG. **1**A is a schematic block diagram of a multimedia stream buffer module according to an embodiment;

FIG. **1**B is a schematic block diagram of a multimedia stream buffer module according to an embodiment;

FIG. **1**C is a schematic block diagram of a multimedia stream buffer module according to an embodiment;

FIG. **1**D is a schematic block diagram of a multimedia stream buffer module according to an embodiment;

FIG. **2** is a schematic diagram of a first buffer according to an embodiment;

FIG. **3** is a schematic flow chart of a multimedia stream buffer and output method according to an embodiment;

FIG. **4**A to FIG. **4**D are schematic diagrams of the output of a first buffer according to an embodiment;

FIG. **5** is a schematic flow chart of Step S**700** according to an embodiment; and

FIG. **6** is a schematic flow chart of Step S**700** according to an embodiment.

DETAILED DESCRIPTION

In the following detailed description, for purposes of explanation, numerous specific details are set forth in order to

provide a thorough understanding of the disclosed embodiments. It will be apparent, however, that one or more embodiments may be practiced without these specific details. In other instances, well-known structures and devices are schematically shown in order to simplify the drawing.

Embodiments of the disclosure provide a multimedia stream buffer and output method and a multimedia stream buffer module. The multimedia stream buffer module comprises a controller and a first buffer, and can be used for performing the multimedia stream buffer and output method.

Referring to FIG. **1**A, FIG. **1**A is a schematic block diagram of a multimedia stream buffer module according to an embodiment. In the embodiment in FIG. **1**A, a multimedia stream buffer module **30** is disposed in a user-end electronic device **20**. In this and some embodiments, the electronic device **20** is a terminal device, for example, a mobile phone, a notebook computer, a tablet computer, or a portable game console, that can communicate with a network. In this and some embodiments, the electronic device **20** comprises a player **22** for playing a multimedia stream, for example, an audio, a video or a high definition video, which has a stream format.

The player **22** includes a second buffer **24** which is taken as a playback buffer and used for temporarily storing a small part of the multimedia stream, and for decoding and playing the part temporarily stored in the second buffer **24**. For example, in this and some embodiments, the player **22** is a Video LAN Client (VLC) multimedia player, the QuickTime or the Windows Media Player.

Generally, a storage space of the second buffer **24** is smaller than that of the first buffer **34**. If the player **22** is mini and has simple functions, the second buffer **24** become much smaller. Therefore, for a multimedia stream of a high definition video, the second buffer **24** might saves few stream frames. In this embodiment, the first buffer **34** of the multimedia stream buffer module **30** and the second buffer **24** of the player **22** are disposed in the same electronic device **20**.

In addition, in an embodiment, the controller **32** further comprises at least one processor for performing relevant control procedures.

In another embodiment, the controller **32** can be embodied with a circuit design and be implemented on a chip. Specifically, any embodiment can be implemented by using a hardware description language (such as Verilog or the VHSIC hardware description language (VHDL)) for its circuit design, including the circuit integration and the layout. A circuit may be designed utilizing the hardware description language in numerous manners. For example, the manufacturer of integrated circuits may realize implementation with application-specific integrated circuits (ASIC) or customer-design integrated circuits.

In this and some embodiments, the multimedia stream is received by the multimedia stream buffer module **30** from a multimedia server **40**. More specifically, in this and some embodiments, the multimedia server **40** includes a multimedia source **42** such as a hard disk, a Redundant Array of Inexpensive Disk (RAID) or a Network camera (or referred to as IP Camera), and provides the multimedia stream buffer module **30** with the multimedia stream through a client-server technology.

Referring to FIG. **1**B, FIG. **1**B is a schematic block diagram of a multimedia stream buffer module according to an embodiment. In this embodiment, a first buffer **34** of a multimedia stream buffer module **30** and a second buffer **24** of a player **22** are also disposed in the same electronic device **20**. However, the multimedia stream buffer module **30** receives a multimedia stream from a Peer to Peer (P2P) node **50** through a P2P technology.

In the P2P technology, data can be transmitted among a plurality of P2P nodes **50**. When as long as at least one P2P node **50** includes a multimedia source **52**, the multimedia stream buffer module **30** can obtain the multimedia stream directly from the P2P node **50** including the multimedia source **52**, or obtain the multimedia stream indirectly from other P2P nodes **50**.

Referring to FIG. **1**C, FIG. **1**C is a schematic block diagram of a multimedia stream buffer module according to an embodiment. In this embodiment, the multimedia stream buffer module **30** is disposed at a near-end node **62** in a Local Area Network (LAN, also referred to as an intranet) **60**, and the near-end node **62** is different from the electronic device **20** including a player **22**. By a wireless manner or a wired manner, the electronic device **20** in the LAN **60** can access a Wide Area Network (WAN, also referred to as extranet) or the Internet through the near-end node **62**.

The near-end node **62** can receive multimedia streams from a multimedia server **40** through a client-server technology, and then provides the multimedia streams to the electronic device **20** for displaying. If the electronic device **20** is a small-size device such as a mobile phone or a portable game console, a storage space of the second buffer **24** thereof is generally small. Therefore, for a multimedia stream of a high definition video, the second buffer **24** might save few stream frames.

In an embodiment, the multimedia server **40** is in the LAN **60**.

Referring to FIG. **1**D, FIG. **1**D is a schematic block diagram of a multimedia stream buffer module according to an embodiment. In this embodiment, the multimedia stream buffer module **30** is disposed in a near-end node **62** in a LAN **60**. The near-end node **62** is different from an electronic device **20** including a player **22**. Besides, the multimedia stream buffer module **30** can receive multimedia streams from a P2P node **50** through a P2P technology. As similar as the embodiment in FIG. **1**C, if the electronic device **20** is a small-size device such as a mobile phone or a portable game console, the storage space of a second buffer **24** is generally small.

The multimedia stream is sent out and received through multimedia stream packets, and a first buffer **34** of the multimedia stream buffer module **30** can be used for storing the multimedia stream packets. Payloads of the multimedia stream packets are a part of the transmitted multimedia stream, for example, a data part or an audio part in a frame in the video.

According to an embodiment, the multimedia stream buffer module **30** sets the size of the first buffer **34** according to the type of the multimedia stream, so that the first buffer **34** corresponds to a buffer time. For example, when the multimedia stream is a high definition video, the buffer time is set as a play time of 1 second. If the high definition video has 24 frames per second, the size of the first buffer **34** should be capable of containing 24 frames of the high definition video. If a play time of the multimedia stream is greater than the buffer time, in this and some embodiments, a plurality of first buffers **34** are disposed.

Referring to FIG. **2**, FIG. **2** is a schematic diagram of a first buffer according to an embodiment. In this and some embodiments, the multimedia stream buffer module **30** comprises a buffer **33**, and the buffer **33** comprises a plurality of first buffers **34**. Each first buffer **34** corresponds to a buffer time, and is divided into a plurality of buffer units **36** according to

a time unit. For example, when the buffer time is 1 second, that is, the time unit is 1/16 second, one first buffer **34** is divided into 16 buffer units **36**. Besides, in this and some embodiments, each buffer unit **36** has a unique buffer index as an identification code.

The buffer units **36**, according to the actual division condition and the size of the multimedia stream packets, have the following possible situations: one buffer unit **36** stores one multimedia stream packet; one buffer unit **36** stores a plurality of multimedia stream packets; and a plurality of buffer units **36** are used to store one multimedia stream packet.

In the disclosure, the multimedia stream buffer and output method and the multimedia stream buffer module **30** perform the buffer and output control actively, and gradually output the content of the first buffer **34** to the second buffer **24** actively. The player **22** does not request data from the multimedia stream buffer module **30** according to its decoding speed.

The multimedia stream buffer and output method, provided in the disclosure, is described with reference to FIG. **3** to FIG. **4**D. FIG. **3** is a schematic flow chart of a multimedia stream buffer and output method according to an embodiment, and FIG. **4**A to FIG. **4**D are schematic diagrams of the output of a first buffer. Values in the description are merely used for describing the embodiments, and actual values can be set according to actual situations.

Firstly, a multimedia stream buffer module **30** receives a plurality of multimedia stream packets from a multimedia server **40** or a P2P node **50**, and stores the multimedia stream packets into a first buffer **34** (Step S**100**). In this and some embodiments, the multimedia stream buffer module **30** stores the multimedia stream packets into a buffer **33**, and fills a plurality of first buffers **34** simultaneously. The output control on one filled first buffer **34** is described by the following steps S**200** to S**800**, and whereby a controller **32** can control the output of each filled first buffer **34** in order.

According to an embodiment, the multimedia stream buffer module **30** establishes a piece of index information for each multimedia stream packet that is already received or is being received, so as to record a temporary storage and output situations of the multimedia stream. In this and some embodiments, an address pointer indicating a location of packet payload content in the entire multimedia stream, a total length of the multimedia stream packet or a length of the payload thereof, a timestamp of the multimedia stream packet, information indicating whether the multimedia stream packet is output to the second buffer **24**, and a group index of a group which the multimedia stream packet belongs to, are recoded in the index information.

The timestamp refers to the time when the payload content should be played in the entire multimedia stream, rather than the time when the multimedia stream packet is sent by the multimedia server **40** or the P2P node **50**. Multimedia stream packets having the same timestamp belong to the same group. For example, multimedia stream packets of frames or audio that the payload contents are set to be played at 0:01:05:10 (hour:minute:second:millisecond), belong to the same group.

The controller **32** then calculates an actual remaining time according to an accumulated idle time and a buffer time (Step S**200**), and determines whether the actual remaining time is greater than a remaining time threshold value (Step S**300**). An initial value of the accumulated idle time is 0, and the accumulated idle time is initialized to 0 when the output control on the first buffer **34** is started. The actual remaining time is equal to the buffer time minus the accumulated idle time. As shown in FIG. **4**A, at the beginning of the output control on the first buffer **34**, the initial value of the accumulated idle time is 0. It is assumed that the buffer time is 1 second and a remaining time threshold value is 6/16 second. Then it is calculated that the actual remaining time is equal to 1 second (1−0=1), and the actual remaining time is greater than the remaining time threshold value.

When the actual remaining time is greater than the remaining time threshold value, the controller **32** performs the following Step S**400** to Step S**700**, so as to output the multimedia stream packets stored in a part of the buffer units **36**.

First, the controller **32** reads a first present time of the multimedia stream buffer module **30** and executes a sleep instruction, so as to wait for a preset idle time (Step S**400**). In this and some embodiments, the preset idle time is N times of a time unit, where N is a positive integer greater than or equal to 2. After the performing of the sleep instruction is finished, the controller **32** reads a second present time, and calculates an actual idle time according to the first present time and the second present time. The actual idle time is different from the preset idle time (Step S**500**). The first present time is the time when the performing of the sleep instruction starts, and the second present time is the time when the performing of the sleep instruction finishes. Moreover, in this and some embodiments, system time maintained by an operating system of an electronic device **20** or of a near-end node **62**, which includes the multimedia stream buffer module **30**, is read and taken as the first present time and the second present time.

In this and some embodiments, the controller **32** uses the second present time minus the first present time, as the actual idle time. During the actual waiting, it is difficult to precisely wake up and control the buffer and output procedure after the preset idle time, so that the controller **32** calculates the accurate actual idle time to precisely control the output of the first buffer **34**.

After obtaining the actual idle time, the controller **32** accumulates the accumulated idle time according to the actual idle time (Step S**600**). In this and some embodiments, the controller **32** first performs a ceiling function on the actual idle time with the time unit as a unit, and takes the current accumulated idle time plus the result of the ceiling function as the accumulated idle time till the end of the current waiting.

Taking the embodiment in FIG. **4**B as an example, it is assumed that the time unit is 1/16 second, the preset idle time is 4/16 second, and the actual idle time is 17/64 second. After taking ceiling with 1/16 second as a unit, the actual idle time becomes 5/16 second. The initial value of the accumulated idle time is 0, so that the latest accumulated idle time accumulated till the end of the current waiting is 5/16 second.

The controller **32** then enables a part of the buffer units **36** according to the accumulated idle time to output the stored multimedia stream packets to the second buffer **24** of the player **22** (Step S**700**). The detailed operation of the Step S**700** is described in FIG. **5**. FIG. **5** is a schematic flow chart of Step S**700** according to an embodiment.

In this and some embodiments, in Step S**700**, the controller **32** first reads timestamps of the multimedia stream packets in the part of buffer units **36** corresponding to the actual idle time (Step S**710**). Taking the embodiment in FIG. **4**B as an example, the current actual idle time corresponds to five buffer units **36** with the buffer indexes being 1 to 5. The controller **32** reads timestamps recorded in the multimedia stream packets from the headers of the multimedia stream packets stored in the five buffer units **36** with the buffer indexes being 1 to 5.

The controller **32** determines whether the multimedia stream packets have the timestamps smaller than the accumulated idle time calculated above, and then outputs the multimedia stream packets with the timestamps smaller than the

accumulated idle time to the second buffer **24** of the player **22** (Step S**720**). Therefore, in Step S**720**, the multimedia stream buffer module **30** transmits the multimedia stream packets which have the timestamps smaller than the accumulated idle time and are temporarily stored in the buffer units **36** with the buffer indexes being 1 to 5, to the second buffer **24**.

Referring to FIG. **6**, FIG. **6** is a schematic flow chart of Step S**700** according to another embodiment. In this embodiment, the controller **32** does not read any timestamp, but determines which the multimedia stream packets should be output, according to an output ratio.

In Step S**700**, the controller **32** first calculates a ratio between the accumulated idle time and the buffer time, and takes the calculated ratio as the output ratio (Step S**750**). Subsequently, and the controller **32** calculates a preset output number according to the amount of all of the multimedia stream packets in the first buffer **34** and according to the output ratio (Step S**760**). In this and some embodiments, when the controller **32** calculates the preset output number, a ceiling function is used for round the preset output number to a positive integer. For example, it is assumed that the accumulated idle time is 5/16 second, the buffer time is 1 second, and the amount of the multimedia stream packets in the first buffer **34** is 48. Then the output ratio is 5/16 ((5/16)/1=5/16), and the preset output number is 15 (48×(5/16)=15).

Subsequently, the controller **32** enables a part of the buffer units **36** according to the preset output number to output the stored multimedia stream packets to the second buffer **24** of the player **22** (Step S**770**). In this and some embodiments, as similar as the accumulated idle time, the controller **32** maintains an accumulated output number, so as to record the amount of the multimedia stream packets outputted by the first buffer **34** so far. An initial value of the accumulated output number is 0, and the accumulated output number is initialized to 0 when the output control on the first buffer **34** starts.

In this and some embodiments, the controller **32** takes the preset output number minus the accumulated output number, as a current output number, and the current output number represents the amount of the multimedia stream packets that should be output after the step of waiting for the preset idle time is end. In this and some embodiments, the controller **32** further controls the buffer units **36** that have not output any multimedia stream packet, to output the stored multimedia stream packets, and the amount of the outputted multimedia stream packets is the current output number.

For example, it is assumed that the preset output number is 15 and the accumulated output number is 0. Then the current output number is 15 (30−15 =15). Therefore, 15 consecutive multimedia stream packets that have not been output before can be selected in order from a buffer unit **36** with a smallest buffer index, and the selected 15 consecutive multimedia stream packets are output to the second buffer **24**. Further, it is assumed that the preset output number is 30 and the accumulated output number is 15. Then the 16^{th} multimedia stream packet to the 30^{th} multimedia stream packet can be output.

In other words, the multimedia stream packets stored in the first buffer can be output according to the ratio between the accumulated idle time and the buffer time. After the multimedia stream packets are output, the controller **32** adds the current accumulated output number and the current output number up to obtain the accumulated output number till the end of the current output.

According to the manner in the foregoing Step S**400** to Step S**700**, the controller **32** can repeatedly execute the sleep instruction and the output control, until the actual remaining time is smaller than or equal to the remaining time threshold value. After the operation described in FIG. **4**A and FIG. **4**B, the controller **32** outputs all the multimedia stream packets in the first buffer **34** to the second buffer **24**, as shown in FIG. **4**C and FIG. **4**D.

In FIG. **4**C, it is assumed that the preset idle time is 4/16 second, the actual idle time is 19/64 second, and the original accumulated idle time is 5/16 second. Therefore, till the end of the current waiting, the accumulated idle time is 10/16 second, and the output ratio is 10/16. Moreover, the controller **32** outputs the multimedia stream packets in five buffer units **36** having the buffer indexes being 6 to 10, to the second buffer **24** according to the timestamps or the output ratio.

In FIG. **4**D, the actual remaining time is 6/16, which is smaller than or equal to the remaining time threshold value, so that the controller **32** enables the rest of the buffer units **36** in the first buffer **34** to output their multimedia stream packets to the second buffer **24** of the player **22** (Step S**800**). In order to avoid an extra waiting period spent on the few rest of the multimedia stream packets, in this and some embodiments, the remaining time threshold value is set to a value greater than an average value of the preset idle time, and when the actual remaining time is smaller than or equal to the remaining time threshold value, the rest of the remaining multimedia stream packets are output simultaneously.

Besides, in order to perform the output control precisely, units of parameters such as the time unit, preset idle time, actual idle time, accumulated idle time, actual remaining time and the remaining time threshold value can be set to Millisecond (ms). For example, the time unit used for dividing the buffer units **36** is set to 10 ms, the preset idle time is set to 20 ms, and the remaining time threshold value is set to 50 ms.

On the other hand, the output control is performed by using the timestamps of the multimedia stream packets or by the ratio between the accumulated idle time and the buffer time. Thus, the multimedia stream buffer and output method and the multimedia stream buffer module are applicable to various players and communication protocols, and can be implemented even in a mini player or through a simple User Datagram Protocol (UDP).

The method may perform the steps in an order different form that disclosed here.

As set forth above, the multimedia stream buffer and output method and the multimedia stream buffer module divide the first module into smaller buffer units and calculate the actual idle time so as to control the output of the first buffer more precisely. Moreover, the actual idle time is calculated according to the system time maintained by the operating system, so that no error may occur to the control. Regardless of the input speed of the multimedia stream, data of the multimedia stream may be continuously and smoothly output to the player.

What is claimed is:

1. A multimedia stream buffer and output method, comprising:

receiving a plurality of multimedia stream packets, and storing the multimedia stream packets into a first buffer, the first buffer corresponding to a buffer time, and the first buffer being divided into a plurality of buffer units according to a time unit;

calculating an actual remaining time according to an accumulated idle time and the buffer time; and

when the actual remaining time is greater than a remaining time threshold value, performing the following steps:

reading a first present time and executing a sleep instruction, so as to wait for a preset idle time;

reading a second present time, and calculating an actual idle time according to the first present time and the second present time, the actual idle time being different from the preset idle time;

accumulating the accumulated idle time according to the actual idle time; and

enabling a part of the buffer units according to the accumulated idle time to output the stored multimedia stream packets to a second buffer of a player.

2. The multimedia stream buffer and output method according to claim **1**, wherein the step of enabling the part of the buffer units to output the stored multimedia stream packets to the second buffer of the player comprises:

reading a timestamp of at least one multimedia stream packet in the part of the buffer units corresponding to the actual idle time; and

outputting the multimedia stream packet having the timestamp being smaller than the accumulated idle time, to the second buffer of the player.

3. The multimedia stream buffer and output method according to claim **1**, wherein the step of enabling the part of the buffer units to output the stored multimedia stream packets to the second buffer of the player according to the accumulated idle time comprises:

calculating a ratio between the accumulated idle time and the buffer time and taking the calculated ratio as an output ratio;

calculating a preset output number according to an amount of all the multimedia stream packets in the first buffer and according to the output ratio; and

enabling the part of the buffer units to output the stored multimedia stream packets to the second buffer of the player according to the preset output number.

4. The multimedia stream buffer and output method according to claim **1**, further comprising:

when the actual remaining time is smaller than or equal to the remaining time threshold value, enabling the rest of the remaining buffer units in the first buffer to output the stored multimedia stream packets to the second buffer of the player.

5. The multimedia stream buffer and output method according to claim **1**, wherein the multimedia stream is received from a multimedia server or received from a Peer to Peer (P2P) node through a P2P technology.

6. The multimedia stream buffer and output method according to claim **1**, wherein the first buffer and the player are disposed in an electronic device.

7. The multimedia stream buffer and output method according to claim **1**, wherein the first buffer is disposed at a near-end node.

8. The multimedia stream buffer and output method according to claim **1**, wherein payloads of the multimedia stream packets belong to a high definition video.

9. The multimedia stream buffer and output method according to claim **1**, wherein the preset idle time is N times of the time unit, and N is a positive integer greater than or equal to 2.

10. A multimedia stream buffer module, comprising:

a first buffer, for storing a plurality of multimedia stream packets, the first buffer corresponding to a buffer time, and the first buffer being divided into a plurality of buffer units according to a time unit;

a controller, used for performing following steps:

receiving the multimedia stream packets and storing the multimedia stream packets into the first buffer;

calculating an actual remaining time according to an accumulated idle time and the buffer time; and

when the actual remaining time is greater than a remaining time threshold value, performing following steps:

reading a first present time and executing a sleep instruction, so as to wait for a preset idle time;

reading a second present time, and calculating an actual idle time according to the first present time and the second present time, the actual idle time being different from the preset idle time;

accumulating the accumulated idle time according to the actual idle time; and

enabling a part of the buffer units according to the accumulated idle time to output the stored multimedia stream packets to a second buffer of a player.

11. The multimedia stream buffer module according to claim **10**, wherein in the step of enabling the part of the buffer units to output the stored multimedia stream packets to the second buffer of the player according to the accumulated idle time, the controller performs following steps:

reading a timestamp of at least one multimedia stream packet in the part of the buffer units corresponding to the actual idle time; and

sending the multimedia stream packet having the timestamp smaller than the accumulated idle time, to the second buffer of the player.

12. The multimedia stream buffer module according to claim **10**, wherein in the step of enabling the part of the buffer units to output the stored multimedia stream packets to the second buffer of the player according to the accumulated idle time, the controller performs following steps:

calculating a ratio between the accumulated idle time and the buffer time and taking the calculated ratio as an output ratio;

calculating a preset output number according to an amount of all the multimedia stream packets in the first buffer and according to the output ratio; and

enabling the part of the buffer units according to the preset output number to output the stored multimedia stream packets to the second buffer of the player.

13. The multimedia stream buffer module according to claim **10**, wherein when the actual remaining time is smaller than or equal to the remaining time threshold value, the controller enables the rest of the buffer units in the first buffer to output the stored multimedia stream packets to the second buffer of the player.

14. The multimedia stream buffer module according to claim **10**, wherein the multimedia stream is received from a multimedia server or received from a Peer to Peer (P2P) node through a P2P technology.

15. The multimedia stream buffer module according to claim **10**, wherein the multimedia stream buffer module is disposed in an electronic device with the player.

16. The multimedia stream buffer module according to claim **10**, wherein the multimedia stream buffer module is disposed at a near-end node.

17. The multimedia stream buffer module according to claim **10**, wherein payloads of the multimedia stream packets belong to a high definition video.

18. The multimedia stream buffer module according to claim **10**, wherein the preset idle time is N times of the time unit, and N is a positive integer greater than or equal to 2.

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